
Solanum anomalostemon (Solanaceae), an Endangered New Species from Southern Peru with Unusual Anther Morphology

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ABSTRACT. *Solanum anomalostemon* S. Knapp & M. Nee is described from Cusco in southern Peru. The species is endemic to the Río Apurímac basin and is known from very few collections. The new species has unique anther morphology within *Solanum* L.; this is compared to other anther variants in the genus. Potential relationships of this unusual and enigmatic species are discussed, the new species is illustrated, and a preliminary conservation assessment of Endangered (EN) is proposed.

RESUMEN. *Solanum anomalostemon* S. Knapp & M. Nee se describe de Cusco para el sur de Perú. La especie es endémica de la cuenca del Río Apurímac y conocida por muy pocas colecciones. La especie nueva tiene anteras con una morfología única en *Solanum* L., que son comparadas con otras variaciones de anteras en el género. Las relaciones potenciales de *S. anomalostemon* están detalladas; se ilustra la especie y se le atribuye un estado de conservación preliminar de En Peligro (EN).

Key words: Anther morphology, IUCN Red List, Peru, Solanaceae, *Solanum*.

Solanum L., with ca. 1500 species, is the largest genus in the Solanaceae and one of the 10 most species-rich genera of flowering plants (Frodin, 2004). The highest species diversity in the genus occurs in South America and is concentrated in the Andes (Knapp, 2002a). As part of the collaborative project “PBI *Solanum*: A world-wide treatment” (see Knapp et al., 2004; <<http://www.nhm.ac.uk/solanaceaesource>>), descriptions of all species of *Solanum* are being provided online. This intensity of work in the genus by a large number of collaborators, along with the massive increase in specimens available from the Andean regions of South America and intensive work in the undetermined collections of herbaria worldwide, has meant that many new taxa are being discovered

(Knapp, 2005, 2007; Granados-Tochoy & Orozco, 2006; Nee et al., 2006; Granados-Tochoy et al., 2007). In addition, the intensive global monographic project, in conjunction with a commitment by the botanical community to achieving Targets 1 (a global plant species checklist) and 2 (preliminary conservation assessments for all known plant species) of the *Global Strategy for Plant Conservation* (GSPC; Secretariat of the CBD, 2002), means that recognition and description of endemic taxa or those facing a significant conservation threat is particularly timely.

Our recent work in many herbaria has uncovered an unusual endemic species from southern Peru. Until recently, this species has only been known from sheets collected in the late 1930s, so we feared it might be extinct. However, recent material received at NY from the intensive collecting program being undertaken jointly in southern Peru by personnel of CUZ and MO proved to be this unusual species. Peru forms one of the most species-rich and endemic-rich areas in South America (Knapp, 2002a); the country previously had 102 endemic species (Knapp et al., 2006), and this new species boosts that number to 103.

Solanum anomalostemon S. Knapp & M. Nee, sp. nov. TYPE: Peru. Cusco: Prov. Anta, Dist. Limatambo, Cunyac, 13°33'S, 72°32'W, 2710 m, 3 May 2003 (fl., fr.), *W. Galiano, P. Núñez, G. Calatayud & I. Huamantupa 5109* (holotype, CUZ; isotypes, MO, NY). Figure 1.

Species nova *Solano chamaesarachidio* Bitter similis, sed ab eo habitu suffruticis nani, foliis profunde ternatis vel pinnatifidis, antheris ad basim cordatis et ad apicem prolongatis, stylis et filamentis glabris atque seminibus etuberculatis differt.

Dwarf subshrubs or herbs 30–50 cm, perennial from a woody taproot, branching from near the base; stems robust, ± erect, densely glandular-pubescent

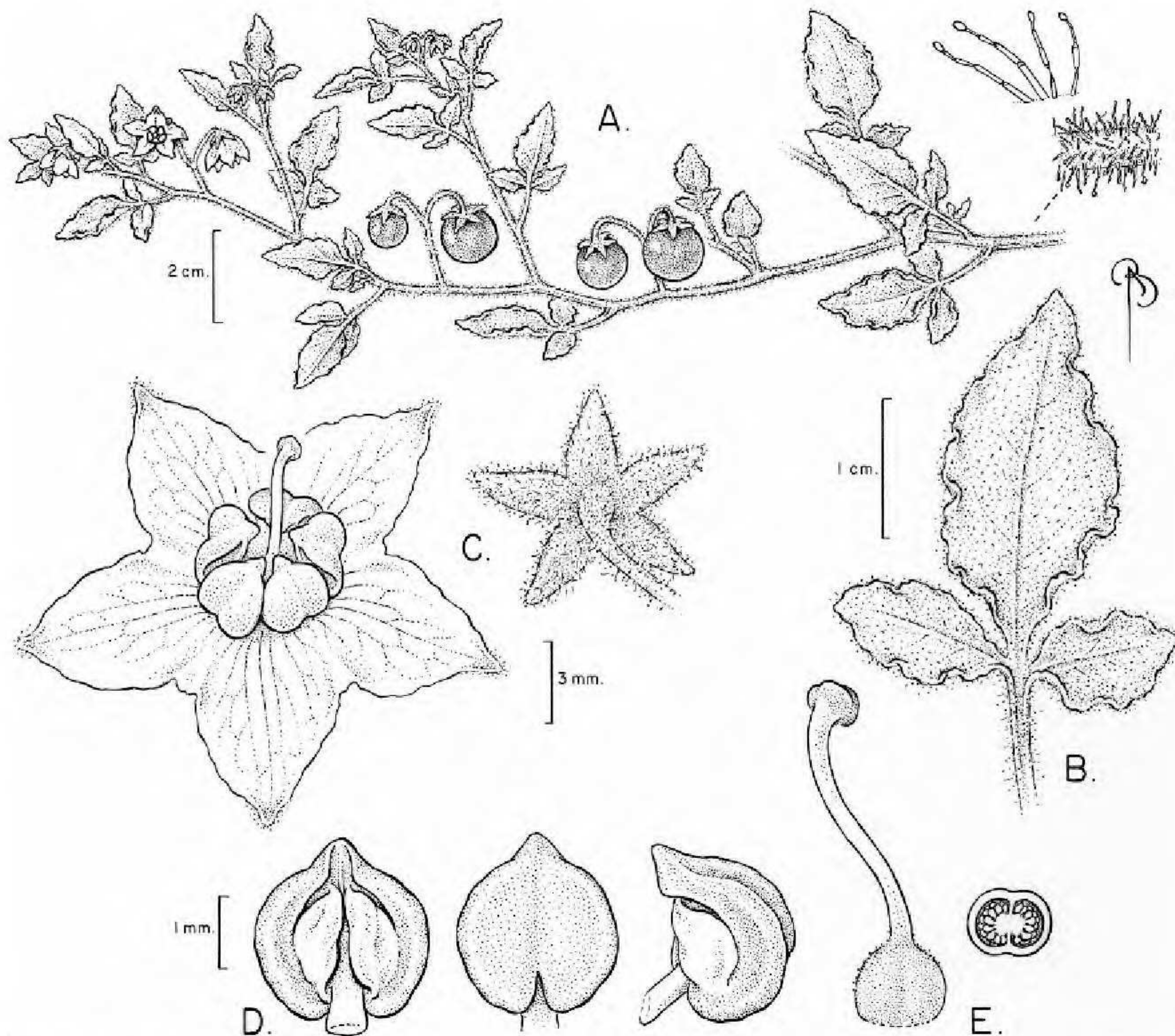


Figure 1. *Solanum anomalostemon* S. Knapp & M. Nee. —A. Habit. —B. Leaf. —C. Flower, with abaxial calyx surface shown at right. —D. Anther (abaxial, adaxial, and side views). —E. Gynoecium, curved style, and capitulate stigma, with ovary cross section shown at right. Drawn from *Galiano et al. 5109* (NY).

with a mixture of glandular and eglandular simple, uniseriate trichomes, 0.3–1 mm; sympodial units not geminate, usually difoliate, but sometimes 3- to 4-foliate. Leaves ternate to pinnatifid, (1–)1.5–3.5 × (1–)1.5–2.5 cm, ± triangular to ovate in outline, thick and succulent, pubescent both adaxially and abaxially with a mixture of glandular and eglandular simple uniseriate 1- to 5-celled trichomes, 0.5–1 mm, the basal cell usually larger and broader, the gland 1-celled; leaflets 3(to 5), usually not discrete but with a wing of connecting leaf tissue; lateral leaflets 1–2 × 0.5–0.8 cm, if leaflets 5 then the basal one much smaller, 0.2–0.5 × ca. 0.2 cm, the base decurrent on the rachis and usually oblique and basiscopically extended, the margins entire to irregularly erose, the apex truncate; terminal leaflet 1.2–2 × 0.7–1.1 cm, always larger than the lateral leaflets, the base attenuate onto the rachis, the margins irregularly erose, the apex truncate; rachis sulcate, densely glandular-pubescent with simple uniseriate trichomes like those of the stems; petiole 1–2 cm, densely pubescent. Inflorescence 1–2 cm, internodal, 2-flowered, densely pubescent with a mixture of glandular and eglandular, uniseriate, simple trichomes, 0.3–0.6 mm; peduncle 1–2 cm, the flowers at the tip of the inflorescence; pedicels 0.5–0.7 cm,

stout, ca. 1 mm diam., densely pubescent like the inflorescence, articulated at the base. Buds globose to slightly depressed-globose, the corolla enclosed in the foliose calyx lobes; flowers all perfect, white; calyx with the tube < 0.5 mm, an open cup, the lobes 2–3 × 1–1.5 mm, elliptic to somewhat spatulate, densely pubescent on both surfaces with eglandular simple uniseriate trichomes, ca. 0.3 mm; corolla 1.5–1.7 cm diam., stellate, lobed 1/3–1/2 way to the base, the lobes 0.3–0.5 cm, 0.3–0.4 cm wide at base, deltate, somewhat campanulate at anthesis, with 3 main veins in the center of each lobe, these drying darker, pubescent abaxially with simple uniseriate trichomes, these denser on the lobe midveins, papillate at the tip; stamens 5, equal, the filament tube ca. 0.5 mm, the free portion of the filaments 1–1.1 mm, glabrous, the anthers 2.5–3 × 2–2.1 mm, cordate, abaxially thickened and densely papillate, the basal lobes ca. 0.5 mm, the apex prolonged with a small beak ca. 1 mm long, dehiscing by longitudinal slits from apical pores initially; ovary conical, densely papillate; style 4.5–5 × ca. 1 mm, glabrous, strongly curved at anthesis; stigma ca. 1 mm diam., capitulate, densely papillate. Fruit a globose berry, 1–1.4 cm diam., the pericarp shiny and brittle when dry, black (*Galiano et al. 5109*),

orangish brown when dry; fruiting pedicels $1.2\text{--}1.5 \times 0.1\text{--}0.15$ cm, curving and deflexed; seeds 10 to 20 per berry, $3\text{--}3.1 \times 1.9\text{--}2.1$ mm, somewhat ovoid, reniform in outline, the margins slightly thickened, the testa with sinuate cells, not tuberculate, appearing shallowly pitted and covered with what appears to be remains of fruit pulp.

Distribution. The new species occurs in southern Peru on rocky and clayey arid slopes at ca. 2800 m (ca. $13^{\circ}30'S$, $72^{\circ}40'W$) on either side of the Río Apurímac west of Cusco on the road to Abancay.

IUCN Red List category. *Solanum anomalostemon* is known from only four collections, all collected within 20 km of each other in the Río Apurímac drainage. The species had not been collected for more than half a century until its recent rediscovery in Cusco Department, on the other side of the Apurímac. The dry forests in which it occurs are not widely protected in Peru, and *S. anomalostemon* does not occur in or near any of the Peruvian network of protected areas (see <<http://www.inrena.gob.pe>>). *Solanum anomalostemon* can be added to the list of endemic Peruvian solanums, and using the IUCN Red List criteria (IUCN, 2001) we suggest it be given a preliminary conservation status of Endangered (EN B1a[iii], B2a) based on its restricted distribution (extent of occurrence < 5000 km², area of occupancy < 100 km²), low number of populations (2), and threatened and unprotected habitat. A more thorough assessment is of interest, not only to discover if it still occurs in Apurímac Department on the other side of the Río Apurímac, but also to assess its population size where it does occur.

Phenology. All specimens have both flowers and fruits, so the species appears to flower and fruit throughout the year. It may do so in response to rainfall, as do many species of tomatoes (Peralta et al., 2008).

Etymology. The species epithet is taken from the Greek “anomalogos” (meaning “not agreeing” or “inconsistent”; e.g., anomalous) and “stemon” (meaning “stamen”), in reference to the unique stamens, which are anomalous in the genus *Solanum*.

Discussion. *Solanum anomalostemon* appears to be unique in *Solanum* in its cordate, sharply pointed anthers with a prolonged beak-like apex, which dehisce by longitudinal slits that are only poricidal very briefly at the beginning of anthesis. Otherwise, *Solanum* is remarkably uniform in basic anther morphology in the ca. 1500 species. Approximately 95% of the species are divided between two groups: (1) those with oblong anthers with relatively large terminal pores and later longitudinal dehiscence to a greater or lesser extent (the nonspiny solanums), and

(2) species with attenuate anthers with very small terminal anthers that do not later enlarge (the *Leptostemonum* and *Wendlandii* clades [sensu Bohs, 2005; Weese & Bohs, 2007]). In other nonspiny solanums (excluding the *Wendlandii* clade [sensu Bohs, 2005; Weese & Bohs, 2007]), the anthers split longitudinally with age, but the pores are distinct at the beginning of anthesis (Knapp, 2002b). Throughout *Solanum* many different types of anther modifications occur in almost all of the monophyletic clades in the genus (Levin et al., 2006; Anderson et al., 2006). Heterandry can be present, either by the unequal growth of a single filament (e.g., *S. uncinellum* Lindley of the *Dulcamaroid* clade [sensu Bohs, 2005; Weese & Bohs, 2007], or *S. turneroides* Chodat of the *Brevantherum* clade [sensu Bohs, 2005; Weese & Bohs, 2007]), or by variously unequal anthers (e.g., *S. rostratum* Dunal and all but one of the other species of section *Androceras* (Nuttall) Marzell of the *Leptostemonum* clade). Members of the *Pachyphylla* clade (sensu Bohs, 2005; Weese & Bohs, 2007, formerly *Cyphomandra* Martius ex Sendtner) have unusually thickened connectives, and in the tomatoes the anthers are tightly connate and have a sterile tip that functions as a single pore (Glover et al., 2004; Peralta et al., 2008). The Argentine species *S. delitescens* C. V. Morton, of the *Geminata* clade, has ellipsoid anthers that are narrowed and apparently sterile in the lower third.

The anthers of *Solanum anomalostemon* are most like those of the small section *Chamaesarachidium* Bitter (*S. chamaesarachidium*, *S. gilioides* Rusby, and *S. annuum* C. V. Morton; considered part of the *Morelloid* clade on morphological grounds pending molecular investigation [G. Barboza, pers. comm.]). These tiny, often annual, plants of the high Andes have basally appendaged anthers, somewhat reminiscent of the cordate anther base of *S. anomalostemonum*. In habit and leaf morphology *S. anomalostemon* also resembles the species of section *Chamaesarachidium*: the plants are shrublets or small perennial herbs and the leaves are variously pinnatifid (Barboza, 2005). *Solanum chamaesarachidium* has glandular pubescence like that of *S. anomalostemon*, but has a marked basal connectival extension and is a much smaller, apparently annual plant (Barboza, 2005). The flowers of members of section *Chamaesarachidium* are usually somewhat campanulate at anthesis, as apparently are the flowers of *S. anomalostemon*. The seeds of *S. anomalostemon* are not tuberculate, as are those of all known species of section *Chamaesarachidium*. There are herbaceous species in the Andes of section *Parasolanum* A. Child (*S. tripartitum* Dunal and relatives) with somewhat similar leaves, but these lack the glandular hairs, and anthers are more typical of the nonspiny solanums. Although the relationships of

S. anomalostemon remain obscure at present, we suggest it belongs to the Morelloid clade based on its overall morphology; sequence data, however, suggest it is anomalous in the genus and of uncertain affinities (L. Bohs, pers. comm.).

Paratypes. PERU. **Apurímac:** hillside above Curahuasi, Cuzco region, 9000 ft., 15 Jan. 1938 (fl., fr.), *H. L. Blood & L. Tremelling 209* (NY); Trancapata, Curahuasi, Abancai, Jan. 1938 (fl., fr.), *C. Vargas 756* (F, GH); Trancapata, Curahuasi, 2800 m, 18 Nov. 1938 (fl., fr.), *C. Vargas C. 2000* (K); Prov. Abancay, Disto, Trancapata, Curahuasi, slopes of Garbanzopata, environs of Ccoto-mayo, 2800 m, 9 Nov. 1938 (fl., fr.), *C. Vargas 9611* (F, GH, K).

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